MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EEE 7286 – ENERGY MANAGEMENT IN INDUSTRY

25 FEBRUARY 2017
9:00 AM – 12:00 AM
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 6 pages including cover page with 4 Questions only.

2. Answer ALL questions. The distributions of the marks for each question are as stated.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) (i) Describe any four different forms of energy.

[8 marks]

   (ii) Distinguish between renewable energy and non-renewable energy. State two examples of resources for each type of energy.

[8 marks]

(b) Details of the lamp for a class room are 100-240V, 1350 lm and 23 W. The room size is 10 m x 12 m.

   (i) Determine the minimum illuminance for this class room. Refer to the table in Appendix A.

[2 Marks]

   (ii) Determine the number of lamps required to obtain the minimum illuminance. Assume that the maintenance factor is 0.85 and the coefficient of utilization is 0.7.

[4 Marks]

   (iii) Calculate the total energy per month required for the class room lighting. The lamps are operated for 8 hours/day and 25 days/month.

[3 Marks]

Continued...

Question 2

(a) Explain the Affinity laws with suitable graphs and how the law can be used to save energy in a centrifugal pump system.

[10 marks]

(b) A factory uses a 150 hp motor to run an exhaust fan. The motor efficiency at full load is 0.86. Measured electrical power of the motor during operation is 22 kW.

   (i) Calculate the loading factor of the motor.

[4 marks]

   (ii) Calculate the total power loss in the motor (given efficiency is 0.75 for loading below 50 %).

[3 marks]

(c) Explain two ways to improve efficiency of motor for each of the following applications.

   (i) A conveyor connected to a gear box running at constant speed for 18 hrs/day.

[4 marks]

   (ii) A fan running at a constant speed of 16 hrs/day. Air flow is controlled using dampers.

[4 marks]

Continued...

Question 3

(a) A factory consumes 169,881 kWh per month. The factory uses the D-33 Low Voltage Industrial Tariff. Details of the tariff (in RM) are given below. Calculate the total energy cost (in RM) for the month.

For the first 200 kWh (1 -200 kWh) per month   38.00 sen/kWh
For the next kWh (201 kWh onwards) per month   44.10 sen/kWh

[3 marks]

(b) The capital cost of a power generating equipment in a power plant is RM 180 million. The useful life of the equipment is 20 years and its salvage value is 6.0 % of its total cost. Determine the amount of money to be deposited annually for replacement by sinking-fund method. Assume that the annual compound interest is 5.0 %.

[4 marks]

(c)   State and explain any four tariff structures used by the utilities.

[8 marks]

(d)   Electricity bill details for an industry is given in Table Q3. They use Tariff E2 (Malaysian Utility Tariff) for medium voltage industry.

Table Q3

	kWh Usage	Maximum Demand, kW
Aug-16	170,101	467
Sept-16	156,463	452
Oct-16	158,222	540

(i) Calculate the monthly bill for August and October 2016. The tariff rate is as follows:
    Maximum demand charge = RM 29.60/kW
    Energy charge = RM 0.3370/kWhr

[4 marks]

(ii) Explain two ways to minimize high maximum demand charge.

[6 marks]

Continued…

Question 4

(a) Thermal insulation plays an important role in improving the thermal efficiency of buildings. State any two types of insulation and insulation materials commonly used in a building.

[8 marks]

(b) What is a captive power plant? Discuss the need for a captive power plant in an industry.

[8 marks]

(c) A captive power plant (CPP) located in an industry is operating in parallel with the grid. It is desirable to import power from the grid at unity power factor. A capacitor bank is connected at the 11 kV bus of the CPP bus to adjust the power factor. Calculate the real and reactive powers to be imported from the grid and the value of capacitor connected at the 11 kV bus.

Following are the details of the system.
- The total power requirement of the industry is 60 MW at 0.85 power factor lagging.
- Total real and reactive power losses in the distribution system of the industry are 3 MW and 2 MVAR, respectively.
- The real and reactive powers generated by the captive generator are 25 MW and 15 MVAR, respectively.

[9 marks]

Continued...

Appendix A

Table 10. Recommended average illuminance levels

Task and Applications	Illuminance (Lux)	Minimum CRI
a) Lighting for infrequently used area:		
- Minimum service illuminance	20	30
- Interior walkway and car-park	100	40
- Hotel bedroom	100	60
- Lift interior	100	40
- Corridor, passageways, stairs	100	40
- Escalator, travellator	150	40
- Entrance and exit	100	60
- Staff changing room, locker and cleaner room, cloak room, lavatories, stores.	100	60
- Entrance hall, lobbies, waiting room	100	60
- Inquiry desk	300	80
- Gate house	200	80
b) Lighting for working interiors		
- Infrequent reading and writing	200	80
- General offices, shops and stores, reading and writing	300 - 400	80
- Drawing office	300 - 400	85
- Restroom	150	80
- Restaurant, canteen, cafeteria	200	80
- Kitchen	150 - 300	80
- Lounge	150	60
- Bathroom	150	80
- Toilet	100	60
- Bedroom	100	80
- Class room, library	300 - 500	80
- Shop/supermarket/department store	200 - 750	80
- Museum and gallery	300	80
c) Localised lighting for exacting task		
- Proof reading	500	80
- Exacting drawing	1000	80
- Detailed and precise work	2000	80

End of Paper